Chapter 1

Introduction

1.1 Introduction

Population forecasting in Thailand is hampered by the unavailability of accurate mortality data. Although population data are collected from individual households every ten years, in contrast to other countries in South East Asia the data collection form does not enquire about recent mortality. Moreover, statistics based on death certificates are known to undercount mortality, possibly by as much as 15% (see, for example, Prasartkul and Vapattanawong, 2006).

The 2000 Population and Housing Census of Thailand (National Statistical Office, 2002) reveals substantial differences in growth rates from 1990 to 2000 between the 14 provinces in the Southern Region. For example, Phuket Province grew by 50% during this decade, whereas the increase in Nakhon Si Thammarat was just 9%. There were also substantial differences in growth rates between the Muslim and non-Muslim populations in the southern provinces. For example, in Pattani Province the Muslim population of the province (78% in 1990) increased by 19% in the decade from 1990 to 2000 while at the same time the non-Muslim population increased by only 3%, whereas the Muslim population of Krabi (36% in 1990) also increased by 19% during the decade and the non-Muslim population increased by 23%. Although these population changes are influenced by migration (particularly in the case of Phuket) they are mainly determined by differences in fertility rates and different age structures in the resident populations.

Given that up-to-date small-area fertility data are available in Thailand from birth certificate and that small-area population age distributions are also available from the National Statistical Office, it would be possible to use these data as a basis for population projection if only reasonable accurate mortality statistics were available. In such situations model life tables such as those originally developed by Coale and Demeny (1966) could be used. The method underlying these life tables assumes that the age-specific mortality curves for various populations within a region belong to a small number of families each indexed by a parameter that signifies the mortality rate. Information about model life table for small regions is sparse in Thailand. Therefore, the information of mortality patterns by province is essential.

In this thesis our objective is to construct model life tables for the 14 provinces in Southern Thailand, based on mortality statistics by gender, 5-year age group and province provided by the Ministry of Public Health's Bureau of Policy and Strategy (2002).

1.2. Southern Thailand

At the 2000 Population Census, Thailand had 60,916,400 citizens. The country has 76 provinces divided into four regions (northern, northeastern, central, and southern) and 12 zones. While 95% of the people of Thailand are Buddhist, there is a substantial Muslim minority (4.6%), largely scattered in the 14 provinces in the Southern region (population 8,087,000). In the four southernmost provinces the majority of the people are Muslim. Other religions are Christianity, Hinduism and other.

Figure 1.1 shows a map of the 14 provinces in Southern Thailand with the percent Muslim in each.

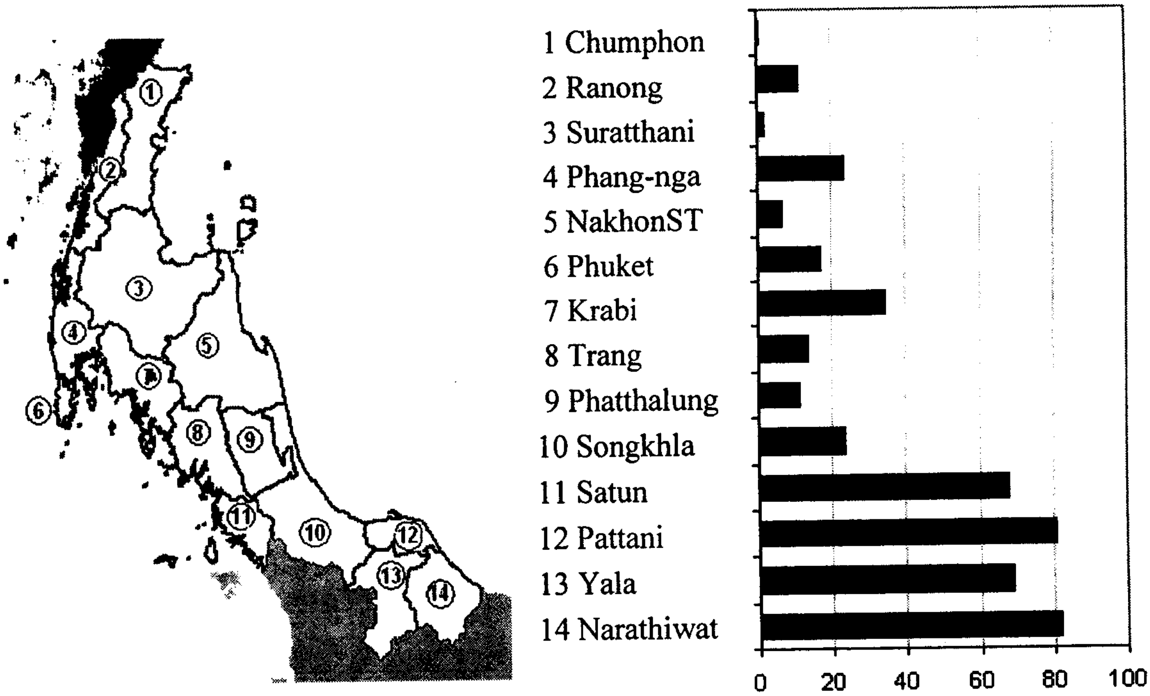

Figure 1.1: Southern provinces with percent Muslim

Percent Muslim ranges from 0.7 to 82.0. The highest is in Narathiwat (82.0%) followed by Patttani (80.7%), Yala (68.9%) and Satun (67.1%). The smallest is Chumphon (0.7%) followed by Suratthani (2.0%), Nakhon Si Thammarat (6.2%) and Phatthalung (11.1%). The population in Southern Thailand also varies in their urban-rural composition, as shown in Figure 1.2.

Figure 1.2 shows a map of the 14 provinces in Southern Thailand with the percent urban in each.

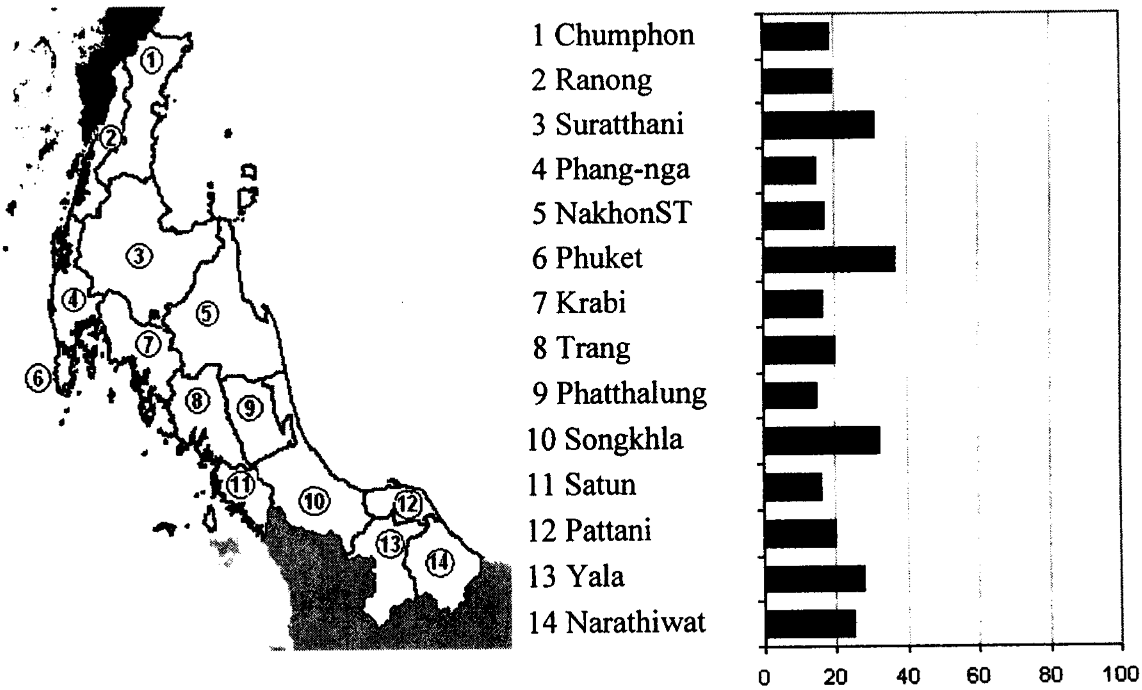

Figure 1.2: Southern provinces with percent urban

There is less variation in percent urban, which ranged from 14.6 to 36.7. The greatest percentage is in Phuket (36.7%) followed by Songkhla (32.4%) and Suratthani (30.9%).

Figure 1.3 shows the percent change of population between 1990 and 2000 of the 14 provinces in Southern Thailand.

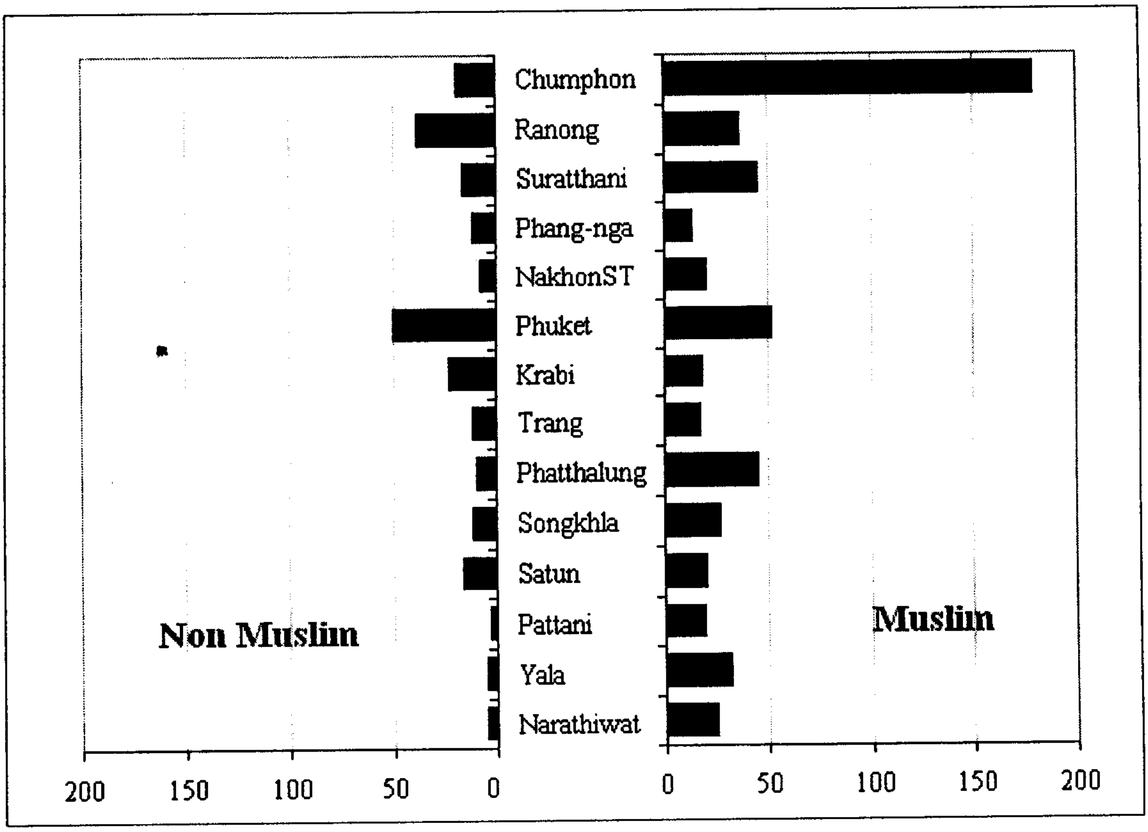

Figure 1.3: Southern provinces with percent change of population

The percent change of population between 1990 and 2000 varied among provinces. The percentage of Muslim people was found to be higher than those of non-Muslim in all provinces except Ranong and Krabi. Chumporn had a Muslim population of 1,122 in 1990 and the number increased to 3,123 in 2000.

1.3. Demography History of Thailand

Thailand's first population census was conducted in 1909 by the Ministry of Interior. Four subsequent censuses followed in 1919, 1929, 1937 and 1947. Since 1960, the National Statistical Office (NSO) has been responsible for undertaking population censuses every ten years under the 1952 Statistical Act (revised in 1965) in accordance with the United Nations' recommendation that countries should undertake national censuses in the year ending with 0 (zero) for the purpose of international comparison, Thailand has conducted its census in 1970, 1980, 1990, and 2000. In 1970, the first housing census was conducted simultaneously with the population census. The tenth population and fourth housing census was carried out in April, 2000 (Lo-Utai, 2005).

Thailand had a population of 8.2 million at the time of its first census in 1909 and the number had increased to 17.4 million at the time of its fifth census in 1947. The population was 26.3 million in 1960, 54.5 million in 1990 and 60.6 million in 2000 as shown in Table 1.1 (National Statistical Office, 2002).

Year	Population	Annual growth rate
1909	8,149,487	-
1919	9,207,355	1.22
1929	11,506,207	2.23
1937	14,464,105	2.86
1947	17,442,689	1.87
1960	26,257,916	3.15
1970	34,397,374	2.70
1980	44,824,540	2.65
1990	54,548,530	1.96
2000	60,606,947	1.05

Table 1.1: The population of Thailand from 1909 to 2000

1.4. Demographic Concepts

Demography is the scientific study of human populations, primarily with respect to their size, their structure and their development. The subject matter of demography mainly concerns itself with the quantitative study of factors such as fertility, mortality and migration, which continuously operate on a population and determine its size and growth and are referred to as components of population growth. This thesis focuses on mortality, especially the life table.

Mortality

Crude death rate: The crude death rate (*mortality rate, M*) in a population during a given year is defined as the total number of deaths (D) divided by the midyear population (P). It is normally expressed per thousand population, so we have

$$M = 1000 \times (D/P).$$

Age-specific death rate: The age-specific death rate (M_x) for individuals age x in a population during a given year is defined as the total number of deaths to people age x during the year (D_x) divided by the total (midyear) population age x (P_x). Expressed per thousand, we have

$$M_x = 1000 \times (D_x/P_x).$$

Note that the crude death rate is simply a weighted average of age-specific death rates, with the weights equal to the proportion of the total population represented by those age x. That is,

$$\Sigma (M_x \times (P_x/P)) = 1000 \times (D/P).$$

This formulation highlights the importance of age composition as a factor influencing the crude death rate.

Life expectancy at birth: Life expectancy at birth (e_0) measures the average number of years that a newborn baby can expect to live. Hence, if life expectancy at birth for 1996 were, say, 75 years, this would mean that a cohort of individuals experiencing the age-specific death rates that prevailed in 1996 would live for an average of 75 years.

A more general aspect of life expectancy is the notion of remaining life expectancy as of age x (e_x). This simply shows the average number of years of life remaining for individuals who reach age x and then experience a given set of age-specific death rates.

Life Table

The life table is the instrument used to determine the chance that a person of a given age will live for a given period or will die at a certain age or any of the more complicated probabilities of living or dying.

Explanation of the columns of the life table

Column 1 Age (*x* to *x* + 5)-This column shows the age interval between the two exact ages indicated. For instance, "20–24" means the 5-year interval between the 20th and 25th birth days.

Column 2 Probability of dying (q_x)-This column shows the probability of dying between ages *x* and *x* + 5. For example, for males in the age interval 20–24 years, the probability of dying is 0.007. The "probability of dying" column forms the basis of the life table; all subsequent columns are derived from it.

Column 3 Number surviving (l_x)-This column shows the number of persons from the original synthetic cohort of 100,000 live births, who survive to the beginning of each age interval. The l_x values are computed from the q_x values, which are successively applied to the remainder of the original 100,000 persons still alive at the beginning of each age interval. Thus out of 100,000 male babies born alive, 98,611 alive at age five; 98,337 alive at age 10; 97,890 alive at age 15; and 23,707 alive at age 85 and over.

Column 4 Number dying (d_x)-This column shows the number dying in each successive age interval out of the original 100,000 live births. For example, out of 100,000 males born alive, 1,389 will die between ages 0 - 4 year of life; 274 will die between ages 5 - 9; and 23,707 will die after reaching age 85 and over. Each figure in column 4 is the difference between two successive figures in column 3.

Column 5 Person-years lived (L_x)-This column shows the number of person-years lived by the synthetic life table cohort within an age interval x to $x + 5$. Each figure in column 5 represents the total time (in years) lived between five indicated birthdays by all those reaching the earlier birthday. Thus, the figure 484,653 for males in the age interval 20 to 25 years is the total number of years lived between the 20th and 25th birthdays by the 97,272 (column 3) males who reach their 20th birthday out of 100,000 males born alive.

Column 6 Total number of person-years lived (T_x)-This column shows the total number of person-years that would be lived after the beginning of the age interval x to $x + 5$ by the synthetic life table cohort. For example, the figure 5,161,638 is the total number of years lived after attaining age 20 - 24 by the 484,653 males reaching that age.

Column 7 Expectation of life (e_x)-The expectation of life at any given age is the average number of years remaining to be lived by those surviving to that age on the basis of a given set of age-specific rates of dying. It is derived by dividing the total person-years that would be lived above age x by the number of persons who survive to that age interval (T_x/l_x). Thus, the average remaining lifetime for males who reach age 20-24 is 53.06 years.

Age	$_nq_x$	l_x	$_nd_x$	$_nL_x$	$_nT_x$	e_x
0 - 4	0.0139	100,000	1,389	496,527	7,129,005	71.29
5 - 9	0.0028	98,611	274	492,369	6,632,478	67.26
10 - 14	0.0045	98,337	447	490,567	6,140,109	62.44
15 - 19	0.0063	97,890	618	487,904	5,649,542	57.71
20 - 24	0.0070	97,272	683	484,653	5,161,638	53.06
25 - 29	0.0181	96,589	1,751	478,569	4,676,985	48.42
30 - 34	0.0223	94,839	2,112	468,914	4,198,415	44.27
35 - 39	0.0222	92,727	2,058	458,490	3,729,502	40.22
40 - 44	0.0201	90,669	1,823	448,789	3,271,012	36.08
45 - 49	0.0233	88,846	2,071	439,054	2,822,223	31.77
50 - 54	0.0328	86,775	2,848	426,757	2,383,169	27.46
55 - 59	0.0454	83,928	3,810	410,113	1,956,412	23.31
60 - 64	0.0708	80,118	5,669	386,416	1,546,299	19.30
65 - 69	0.1222	74,449	9,100	349,492	1,159,883	15.58
70 - 74	0.1936	65,348	12,654	295,106	810,391	12.40
75 - 79	0.2727	52,694	14,367	227,553	515,285	9.78
80 - 84	0.3815	38,327	14,620	155,084	287,732	7.51
85+	1.0000	23,707	23,707	132,648	132,648	5.60

Table 1.2: Life table for males in Pattani province

1.5. Literature Reviews

Model life tables provide ways of deriving accurate mortality schedules or predicting future trends from scanty data. In settings where accurate data are unavailable, these provide invaluable tools for estimating mortality conditions among populations. Constructing model life tables requires the availability of accurate empirical life tables that depict the different patterns of age-specific risk of death in the population covered.

Since the origin of demography, model life tables have been constructed. Coale and Demeny (1966) constructed four families of model life tables based on data from 326 life tables for each sex, mostly from European areas. It was found that the grouping of areas having similar age patterns of mortality produces very high correlations.

Gage (1988) conducted a study on mathematical hazard models of mortality. A five-parameter competing hazard model of the age pattern of mortality was described, and methods of fitting it to survivorship, death rate and age structure data were developed and presented. The methods were then applied to published life table and census data to construct life tables for a Late Woodland population, a Christian period Nubian population, and the Yanomama. The advantage of this approach over the use of model life tables is that the hazard model facilitates life-table construction without imposing a particular age pattern of mortality on the data.

Podhipak (1987) applied models of age and sex mortality, developed by the United Nations in 1982 for developing countries, to data for Thailand for the period 1973-1983. This study revealed the change of mortality patterns in Thailand, moving from the Latin American to the Far Eastern pattern. The proportion mortality ratio of population over 60 years of age had increased from 28.7% in 1973 to 42.0% in 1983.

There are several sets of model life tables (UN model life tables (1955), Coale and Demeny regional model life tables (1966), Brass logit system (1971) and UN model life table for developing countries (1981)). However, these types of models depend on the type of data that generated them, and may be less suitable for small region like Southern Thailand.

Hidajat et al (2007) developed a demographic model of Indonesian population health. Their model was based on the analytic framework of a Markov-based multistate life table model to calculate an important indicator of the burden of disease, the expected duration of active life for elderly Indonesians.

Unger (2006) conducted a study using a multistate life-table modeling approach to estimate active life years. First, mortality risks and the rates of entering and leaving health statuses are estimated by applying multivariate hazard models. In a second step, increment-decrement life tables are constructed by applying age-specific transition rates for three different cohorts.

Garenne (1994) used Coale and Demeny model tables to study sex differences in measles mortality using mortality data from 78 countries between 1950 and 1989.

1.6. Plan of Thesis

This thesis reports our investigation to construct model life tables for the 14 provinces in Southern Thailand, based on mortality statistics by gender, 5-year age group and province. It contains five chapters, including this introductory chapter.

Chapter 2 provides s a description of the computer program, data management, graphical and statistical methods we used.

Chapter 3 covers the age distribution of population. This includes pyramid graphs separated by gender and religion together with life tables for each province. The distribution of the population by area and religion are also investigated.

Chapter 4 covers model life tables using multiple logistic regression.

Finally, Chapter 5 gives a general summary of the previous four chapters and the overall conclusions.